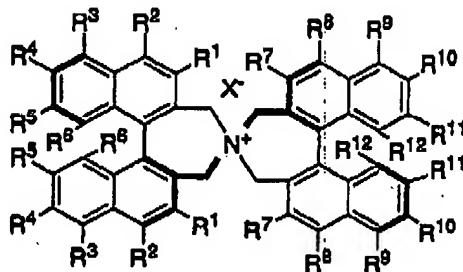


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Appl. No. 10/563,658
November 26, 2008AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (original) An optically active quaternary ammonium salt, represented by the following formula (1a):

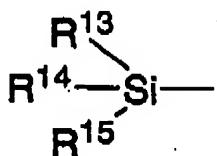


(1 a)

[wherein R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² are each independently a hydrogen atom, a methyl group, an ethyl group, a straight, branched or cyclic alkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic heteroalkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkenyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkynyl group having 3 to 18 carbon atoms, an alkoxy group having 1 to 18 carbon atoms, an aryl group having 5 to 20 carbon atoms, an aralkyl group having 5 to 35 carbon atoms, or a heteroaralkyl group having 5 to 35 carbon atoms;

with the proviso that at least one of R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² is a substituent represented by the following formula (2a):

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(2 a)

(wherein R¹³, R¹⁴, and R¹⁵ are each independently a methyl group, an ethyl group, a vinyl group, a straight, branched or cyclic alkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkenyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkynyl group having 3 to 18 carbon atoms, an alkoxy group having 1 to 18 carbon atoms, an aryl group having 5 to 20 carbon atoms, an aralkyl group having 5 to 25 carbon atoms, or a heteroaralkyl group having 5 to 25 carbon atoms.);

X⁻ is a fluorine ion, a chloride ion, a bromide ion, an iodide ion, a p-toluenesulfonic acid ion, a hydroxide ion, a thiocyanate ion, a hydrogen sulfate ion, a perchloric acid ion, or a hexafluorophosphoric acid ion; and the two binaphthyl moieties each have a chiral axis so that the absolute configurations of the two binaphthyl moieties are (R, R) or (S, S)].

2. (original) The optically active quaternary ammonium salt according to claim 1, wherein R¹ and R⁷, R³ and R⁹, R⁴ and R¹⁰, R⁵ and R¹¹, and R⁶ and R¹² in the formula (1a) are in each case identical to one another; R² and R⁸ are identical to one another and are each represented by the formula (2a); and X⁻ is a fluorine ion, a chloride ion, a bromide ion, an iodide ion, a p-toluenesulfonic acid ion, or a hydroxide ion.

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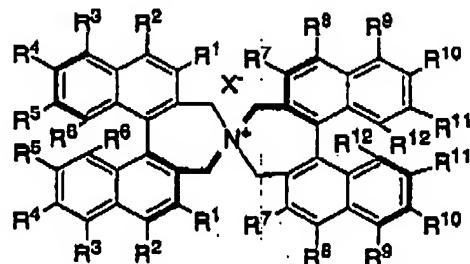
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3. (original) The optically active quaternary ammonium salt according to claim 1, wherein R¹, R³, R⁵, R⁶, R⁷, R⁹, R¹¹, and R¹² in the formula (1a) are each independently a hydrogen atom; R², R⁴, R⁸, and R¹⁰ are identical to one another and are each represented by the formula (2a); and X⁻ is a chloride ion, a bromide ion, an iodide ion, or a p-toluenesulfonic acid ion.

4. (original) The optically active quaternary ammonium salt according to claim 1, wherein in the formula (1a), R¹ and R⁷, R³ and R⁹, R⁴ and R¹⁰, R⁵ and R¹¹, and R⁶ and R¹² are in each case identical to one another, R² and R⁸ are identical to one another and are each represented by the formula (2a), and X⁻ is a bromide ion; and R¹³, R¹⁴ and R¹⁵ in the formula (2a) are each independently a substituent selected from the group consisting of a methyl group, an ethyl group, an n-propyl group, an isopropyl group, an n-butyl group, an isobutyl group, a sec-butyl group, a tert-butyl group, an n-octyl group, and a phenyl group.

5. (original) An optically active quaternary ammonium salt represented by the following formula (1b):

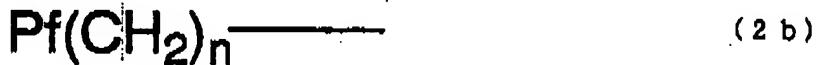


(1 b)

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[wherein R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² are each independently a hydrogen atom, a halogen atom, a methyl group that may or may not be substituted with fluorine, an ethyl group that may or may not be substituted with fluorine, a straight, branched or cyclic alkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic heteroalkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkynyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, an alkoxy group that has 1 to 18 carbon atoms and may or may not be substituted with fluorine, an aryl group that has 5 to 20 carbon atoms and may or may not be substituted with fluorine, an aralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine, or a heteroaralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine;

with the proviso that at least one of R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² is a substituent represented by the following formula (2b):



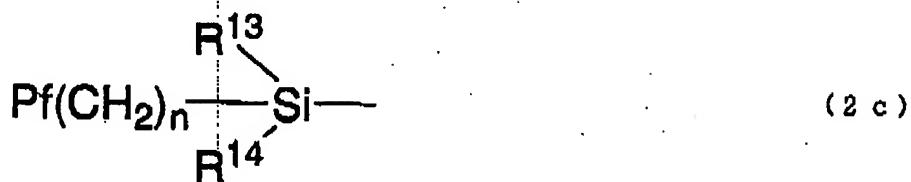
(wherein Pf is a straight, branched or cyclic alkyl group that has 2 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkynyl group that has 3 to 18 carbon atoms and has all the hydrogen

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atoms substituted with fluorine atoms, an aryl group that has 5 to 20 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, an aralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, or a heteroaralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, and n is an integer from 0 to 4.), and/or by the following formula (2c):



(wherein Pf and n are as defined in the formula (2b) above, R¹³ and R¹⁴ are each independently a methyl group, an ethyl group, a vinyl group, a straight, branched or cyclic alkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkenyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkynyl group having 3 to 18 carbon atoms, an alkoxy group having 1 to 18 carbon atoms, an aryl group having 5 to 20 carbon atoms, an aralkyl group having 5 to 25 carbon atoms, or a heteroaralkyl group having 5 to 25 carbon atoms.);

X⁻ is a fluoride ion, a chloride ion, a bromide ion, an iodide ion, a p-toluenesulfonic acid ion, a hydroxide ion, a thiocyanate ion, a hydrogen sulfate ion, a perchloric acid ion, or a hexafluorophosphoric acid ion; and the two binaphthyl moieties each have a chiral axis so that the absolute configurations of the two binaphthyl moieties are (R, R) or (S, S)].

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6. (original) The optically active quaternary ammonium salt according to claim 5, wherein R¹ and R⁷, R³ and R⁹, R⁴ and R¹⁰, R⁵ and R¹¹, and R⁶ and R¹² in the formula (1b) are in each case identical to one another; R² and R⁸ are identical to one another and are each represented by the formula (2a); and X⁻ is a fluorine ion, a chloride ion, a bromide ion, an iodide ion, a p-toluenesulfonic acid ion, a thiocyanate ion, a hydrogen sulfate ion, or a hydroxide ion.

7. (original) The optically active quaternary ammonium salt according to claim 5, wherein R¹, R³, R⁵, R⁶, R⁷, R⁹, R¹¹, and R¹² in the formula (1b) are each independently a hydrogen atom; R², R⁴, R⁸, and R¹⁰ are identical to one another and are each represented by the formula (2c); and X⁻ is a chloride ion, a bromide ion, an iodide ion, or a p-toluenesulfonic acid ion.

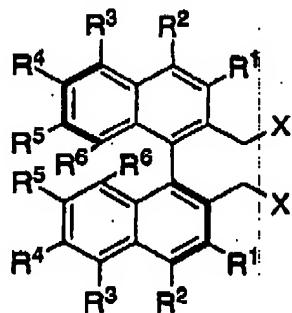
8. (original) The optically active quaternary ammonium salt according to claim 5, wherein in the formula (1b), R¹ and R⁷, R³ and R⁹, R⁴ and R¹⁰, R⁵ and R¹¹, and R⁶ and R¹² are in each case identical to one another, and X⁻ is a bromide ion; and in the formula (2c), n is 2, R¹³ and R¹⁴ are each a methyl group, and Pf is an n-octyl group having all the hydrogen atoms substituted with fluorine atoms.

9.-14. (canceled).

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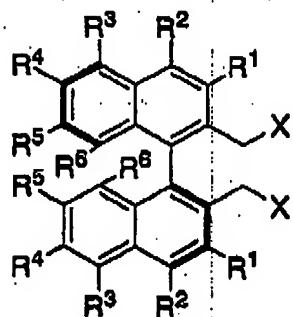
15. (currently amended) A method for producing the optically active quaternary ammonium salt according to claim 1 or claim 5 represented by the formula (1a) or (1b) wherein R¹, R², R³, R⁴, R⁵, and R⁶ are each independently a hydrogen atom, a methyl group, an ethyl group, a straight, branched or cyclic alkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic heteroalkyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkenyl group having 3 to 18 carbon atoms, a straight, branched or cyclic alkynyl group having 3 to 18 carbon atoms, an alkoxyl group having 1 to 18 carbon atoms, an aryl group having 5 to 20 carbon atoms, an aralkyl group having 5 to 35 carbon atoms, or a heteroaralkyl group having 5 to 35 carbon atoms and in which X⁻ is a chloride ion, a bromide ion, a iodide ion, or a p-toluenesulfonic acid ion, characterized in that the optically active binaphthyl compound represented by the formula (3a)



(3a)

or (3b)

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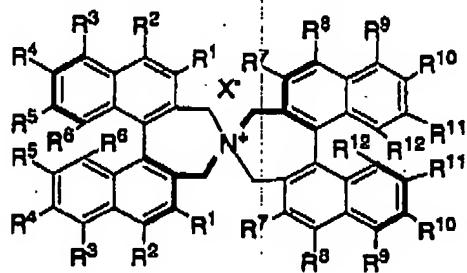
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(3 b)

is reacted with ammonia.

16.-57. (canceled).

58. (currently amended) A method for recovering an optically active quaternary ammonium salt, wherein an organic solvent, water, a mixed solvent of an organic solvent and water, and/or an organic solvent with hydrogen atoms substituted with fluorine atoms are/is used to separate the optically active quaternary ammonium salt according to claim 5 represented by the formula (1b) represented by the following formula (1b):



(1 b)

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[wherein R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , R^7 , R^8 , R^9 , R^{10} , R^{11} , and R^{12} are each independently a hydrogen atom, a halogen atom, a methyl group that may or may not be substituted with fluorine, an ethyl group that may or may not be substituted with fluorine, a straight, branched or cyclic alkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic heteroalkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkynyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, an alkoxy group that has 1 to 18 carbon atoms and may or may not be substituted with fluorine, an aryl group that has 5 to 20 carbon atoms and may or may not be substituted with fluorine, an aralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine, or a heteroaralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine;

with the proviso that at least one of R^1 , R^2 , R^3 , R^4 , R^5 , R^6 , R^7 , R^8 , R^9 , R^{10} , R^{11} , and R^{12} is a substituent represented by the following formula (2b):



(2b)

(wherein Pf is a straight, branched or cyclic alkyl group that has 2 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkynyl group that has 3 to 18 carbon atoms and has all the hydrogen

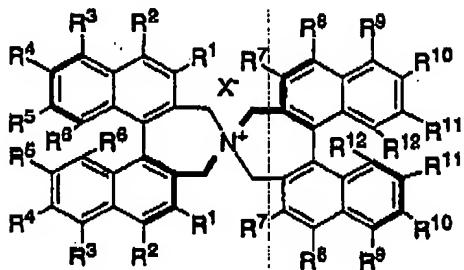
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atoms substituted with fluorine atoms, an aryl group that has 5 to 20 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, an aralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, or a heteroaralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, and n is an integer from 0 to 4.) from a product containing the ammonium salt.

59. (currently amended) A method for recovering the optically active quaternary ammonium salt according to claim 5 represented by the formula (1b), represented by the following formula (1b):



(1 b)

[wherein R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² are each independently a hydrogen atom, a halogen atom, a methyl group that may or may not be substituted with fluorine, an ethyl group that may or may not be substituted with fluorine, a straight, branched or cyclic alkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic heteroalkyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, a straight, branched or cyclic alkynyl

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group that has 3 to 18 carbon atoms and may or may not be substituted with fluorine, an alkoxy group that has 1 to 18 carbon atoms and may or may not be substituted with fluorine, an aryl group that has 5 to 20 carbon atoms and may or may not be substituted with fluorine, an aralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine, or a heteroaralkyl group that has 5 to 35 carbon atoms and may or may not be substituted with fluorine;

with the proviso that at least one of R¹, R², R³, R⁴, R⁵, R⁶, R⁷, R⁸, R⁹, R¹⁰, R¹¹, and R¹² is a substituent represented by the following formula (2b):



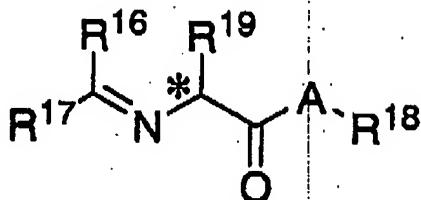
(2 b)

(wherein Pf is a straight, branched or cyclic alkyl group that has 2 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkenyl group that has 3 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, a straight, branched or cyclic alkynyl group that has 3 to 18 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, an aryl group that has 5 to 20 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, an aralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, or a heteroaralkyl group that has 5 to 25 carbon atoms and has all the hydrogen atoms substituted with fluorine atoms, and n is an integer from 0 to 4.) wherein following the production of the compound of the formula (14)

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(1 4)

wherein R¹⁶ and R¹⁷ are each independently a hydrogen atom or an aryl group that has 5 to 10 carbon atoms and may or may not be substituted with halogen, with the proviso that R¹⁶ and R¹⁷ are not a hydrogen atom at the same time;

A is an oxygen atom or a nitrogen atom having a single hydrogen atom bound thereto; and
R¹⁹ is a straight, branched or cyclic alkyl group having 1 to 10 carbon atoms, a straight, branched or cyclic alkenyl group having 3 to 10 carbon atoms, a straight, branched or cyclic alkynyl group having 3 to 10 carbon atoms, or an aralkyl group that has 5 to 25 carbon atoms and may or may not have its nucleus substituted with 1 to 15 halogen atoms;

by the method which is carried out in the presence of the optically active quaternary ammonium salt of the formula (1b), the ammonium salt is separated from the reaction mixture containing the optically active quaternary ammonium salt by using an organic solvent, water, a mixed solvent of an organic solvent and water, and/or an organic solvent with hydrogen atoms substituted with fluorine atoms.

60. (original) The method according to claim 59, wherein hexane with its hydrogen atoms substituted with fluorine atoms is used as the fluorine-substituted organic solvent.